

Sensitivity-Based Simulation Software for Optimization of Turbine Blade Cooling Strategies, Phase I

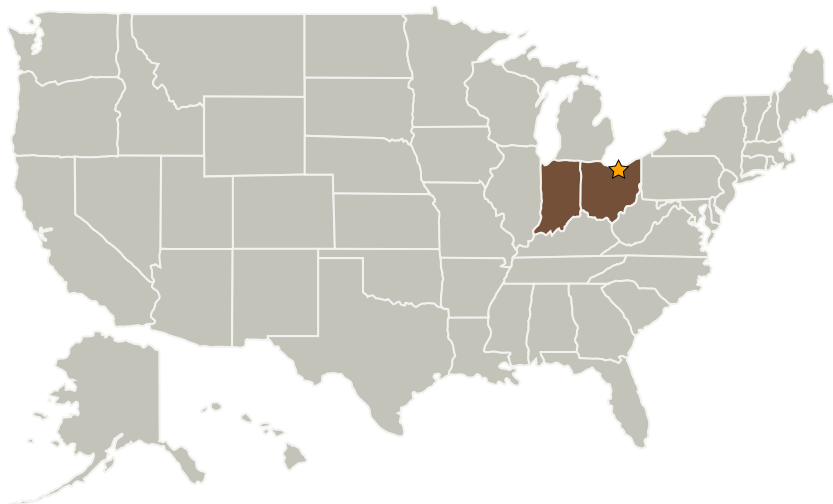
Completed Technology Project (2009 - 2009)



Project Introduction

In recent years, there has been a tendency to use ever-higher gas turbine inlet temperatures, resulting in ever-higher heat loads necessitating efficient cooling. Internal cooling designs have evolved from the use of simple curved ducts in early designs to very complex geometries. Similar complexities govern film cooling as well, leading to complex fluid-structure interactions and turbulence physics. These complexities make it impossible to obtain optimal cooling designs by intuition alone. In this project we propose to develop optimization software for the design and optimization of turbine blade cooling strategies. The objectives of Phase I are to (i) demonstrate the feasibility of accurate single-point physical modeling of internal and film cooling geometries using our CFD solver TETHYS, (ii) demonstrate the feasibility of sensitivity computation and uncertainty quantification using TETHYS, (iii) apply these sensitivity and uncertainty quantification approaches to turbine blade cooling and to demonstrate their advantage over single-point CFD simulations, and (iv) develop and demonstrate multivariate optimization of a chosen turbine blade cooling problem. Phase II will extend our methodology to geometry optimization, the improvement of physical models and numerical schemes, parallel processing on shared and distributed memory platforms and multicore architectures, as well as application to more complex optimization problems.

Primary U.S. Work Locations and Key Partners



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
★ Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
Jabiru Software and Services	Supporting Organization	Industry	West Lafayette, Indiana

Primary U.S. Work Locations	
Indiana	Ohio

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
 - └ TX15.1 Aerosciences
 - └ TX15.1.3 Aeroelasticity